



AEC-NASA TECH BRIEF

Space Nuclear Systems Office



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Producing Graphite with Desired Properties

The search for superior grades of graphite, necessary for the nuclear rocket, has led to major advances in the art. Work at Los Alamos Scientific Laboratory (LASL) has increased the understanding of the properties and behavior of carbon and graphite, yielded improvements in raw materials and processes used in their manufacture, and provided significant insights in how to produce them with consistent, predictable, and useful combinations of properties. To achieve this, LASL employed metallurgical techniques that resulted in new understanding of the microstructure of graphite, including X-ray diffraction, electron and optical microscopy, and porosimetry. An important aspect that LASL has isolated, regarding ability to synthesize either isotropic or anisotropic graphite, is the precise control of particle size, distribution, and shape. As a consequence, it is now possible to convert low-cost commercial coke and natural graphite into isotropic and anisotropic graphite, respectively, with very unusual properties.

Isotropic graphite is uniform mechanically, thermally, and electrically in all directions. The LASL isotropic graphites are not only nearly perfectly isotropic, but their thermal expansion coefficients are two or three times those of ordinary graphites, and they have high electrical resistivities. Because these LASL graphites can be extruded, previous limitations in size and shape have been reduced considerably. Aside from their potential value to nuclear reactors and rocket nozzles, they should prove useful in a wide variety of mechanical applications such as turbine seals, pump impellers and housings, gas compressors, and tools for electric-discharge machining.

Anisotropic graphite differs from isotropic in not having uniform properties. Its strength may lie in one direction while its desirable heat-conduction charac-

teristics lie in another. A popular type of commercial anisotropic graphite is known as pyrolytic; it is formed by deposition of very thin layers of graphite from high-temperature hydrocarbon gases. The LASL anisotropic graphites approach the anisotropy of pyrolytic graphite and have the added advantages of lower cost, much greater section thickness, higher across-grain strength, freedom from delamination, and flexibility with regard to their acceptance of additives such as radiation absorbers and oxidation inhibitors. They offer great promise as high-temperature commercial and aerospace heat shields since they can be molded by low-cost processes; and they appear to be very attractive for high-temperature piping and support structures, and as furnace electrodes for arc melting of steel.

Note:

The following documentation may be obtained from:

Technology Utilization Officer
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